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Annual variations of the presence of Nereididae (Annelida: Polychaeta) from intertidal rocky shores along the east coast of Algeria

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Abstract: Four species of nereidid polychaetes, *Perinereis cultrifera*, *P. macropus*, *Nereis falsa*, and *Platynereis dumerilii*, were identified during three years in four intertidal rocky shore sites (El-Kala, Annaba, Skikda and Collo) along the east coast of Algeria during the years 2011–2013. Species' distribution fluctuated according to sites and season. *Perinereis cultrifera* was observed during most of the year, except in summer. *Perinereis macropus* was observed at El-Kala, Skikda and Collo mainly in late winter and early spring. *Nereis falsa* was observed during most of the year in El-Kala and Annaba; this species was also observed in Skikda in 2011 but then disappeared in the last two years of this study. Finally, the presence of *P. dumerilii* was noticed only in El-Kala for a few months (mainly in March and April). *Perinereis cultrifera*, *P. macropus* and *P. dumerilii* reproduce after acquiring the epitokous form between April and May, when surface seawater temperature starts rising. The largest mature oocytes were about the same for *P. cultrifera* (279 μm) and *P. macropus* (278 μm), while this value was smaller for *P. dumerilii* (166 μm). In contrast to the other three species of nereidid polychaetes, *N. falsa* reproduces without epitokal modification between July and August when sea temperature was highest. The largest mature oocytes (168 μm) are about the same as *P. dumerilii* but is much small than those of *P. cultrifera* and *P. macropus*.

Key words: nereidid polychaetes, species composition, east coast of Algeria, rocky shore, reproduction

INTRODUCTION

There has long been an emphasis on taxonomy in marine studies, and for example, Hedgpeth (1957) recommended that the first procedure in any ecological work or applied research on organisms is the exercise of systematics. No ecological investigation can be successfully carried out without a comprehensive knowledge of the taxonomy of faunal resources. The Nereididae is one of the largest polychaete families (Hutchings et al. 2000) and one of the most widespread and frequently encountered intertidally (Wilson 2000).

A key to the genera of nereidid polychaetes occurring worldwide was given by Fauvel (1923) and later by Fauchald (1977). Classification of Nereididae into subfamilies was introduced by Corrêa (1948) and was later followed by Hartman (1959), Pillai (1961) and Banse (1977), mainly based on groups without paragnaths and papillae, and those with papillae. The nominative subfamily was formally defined phylogenetically by Fitzhugh (1987). Publications synthesizing taxonomic information of Nereididae or a geographical region have sometimes included a short comparative description or a figure of relevant paragnath types (e.g., Day 1967), but there is no complete overview. Phylogenetic analyses (Fitzhugh 1987; Bakken and Wilson 2005; Santos et al. 2005) have increased attention to the diversity of forms of paragnaths as a contribution towards an understanding of evolution within the Nereididae.

There have been few studies about nereidid polychaetes from intertidal rocky shores along the east coast of Algeria. Previous studies by Rouabah and Scaps (2003) documented the population structure and life cycle of the epitokous form of *Perinereis cultrifera* (Grube, 1840). Another study was dedicated to the cycle of reproduction, secondary production and dynamics of a population of *Nereis falsa* (Daas et al. 2010). So, the principal goal of this study was to identify the different species of nereidid polychaetes from intertidal rocky shores along the east coast of Algeria and to study the annual and seasonal variations of their presence. We also measured interannual and intraseasonal variability in reproductive parameters (mode of reproduction,

Figure 1. Location of the sampling sites along the east Algerian coast: El-Kala, Annaba, Skikda, Collo. (EMB: El-Morjène beach, SCB: St-Cloud beach, MOS: Mouth Oued Saf-saf, ADB: Ain Dawla beach).

mean oocyte of mature females, spawning season) of the different species.

MATERIALS AND METHODS

Study area

Sampling sites were chosen on the eastern of Algerian Mediterranean coast along the east coast of Algeria (Figure 1). The maximum tidal range in this region is 0.9 m. Site selection was based on the abundance of species as well as ease of access to the study area. El-Kala (36°53′44″ N, 008°26′35″ E) is close to the Tunisian border (10 km). This site is part of a national park and is not urbanized, therefore, it was considered as the healthy reference site. Annaba (36°54′27″ N, 007°45′26″ E) is located about 80 km from the Tunisian border. This site is exposed to the pollution by pesticides and/or heavy metals released from a fertilizer factory and port activities (Sifi et al. 2007). Skikda (36°45′0″ N, 006°49′60″ E) is located about 180 km from the Tunisian border. This site is near the port of Stora and is characterized by an intense maritime traffic and is also polluted by polycyclic aromatic hydrocarbons (PAH) because of the presence of a petrochemical complex and human activities. Collo (37°00′23″ N, 006°33′39″ E) is located about 250 km from the Tunisian border. This site is 71 km from the east of the province of Skikda. It is bordered on the west by the town of Jijel and on the south by the town of Tamalous. This site is not urbanized.

Collection of individuals

Nereidid worms were collected from among red algae (Rhodophyceae) that was covering hard bottoms (metamorphic rocks of gneiss and quartzite). Nereidids occur in the lower intertidal zone and extend down into the subtidal, and as a consequence, the intertidal and shallow sublittoral hard bottoms were sampled methodically by scraping algae and looking for individuals (Rouabah and Scaps 2003). Samples were made monthly from January to December during three years (2011, 2012 and 2013). During several investigations, the region sampled corresponded with the area of greatest density of individuals. We used bleaching liquid (10% in sea water) to force individuals out of algal mats in order to obtain undamaged, whole individuals. Approximately 6 m^2 of hard bottom was sampled in a 25 cm × 25 cm quadrate. Samples were made 4 to 6 times per month for 4 hours per survey.

Identification of species

Altogether 5,808 worms were collected and examined. For identification of species using diagnostic patterns of paragnaths on the proboscis, worms were made to evert their proboscis by generating pressure some distance behind the head.

Each month, 30 to 46 intact (unamputated) worms were collected at El-Kala, Annaba, Skikda and Collo and transported live to the laboratory. Live worms were persuaded to evert their proboscis by dipping them in 95% ethanol; they then died usually with the proboscis everted. Species identification of Nereididae was based on the distribution of the paragnaths on the surface of the proboscis using the keys by Fauvel (1923). The number of paragnaths in each group was counted under a binocular microscope. The scar left by recent loss of paragnath was scored as if the paragnath was still present.

Reproductive cycle

Individuals were fixed with 95% ethanol and examined for the presence of morphological modifications characteristic of epitoky. A short incision was made in the body wall near the twentieth chaetigerous segment and a drop (~1 ml) of the coelomic fluid was removed with a Pasteur pipette and examined under a binocular microscope. When possible, 30 oocytes were measured using a calibrated eyepiece graticule. The longest and the shortest oocyte length were determined, and the average value was used as an estimate of oocyte size.

Males were recognized by the presence of sperm plates in the coelomic fluid and mature ones by the presence of sperm aggregates. Those animals without sexual products were considered to have an undetermined sex.

RESULTS

Four species were collected in this study, *Perinereis cultrifera* (Grube, 1840), *Perinereis macropus* (Claparède, 1870), *Platynereis dumerilii* (Audouin & Milne-Edwards, 1834), and *Platynereis dumerilii* (Audouin & Milne-Edwards, 1834).

Description of the species

Perinereis cultrifera: Semicylindrical body, 100–125 segments, head with prostomium larger than broad, 2 pairs of eyes, 2 cylindroid palps, 2 pointed antennae and 4 pairs of tentacular cirri. The arrangement of the paragnaths agrees with that depicted by Fauvel (1923) as follows I = one to three in longitudinal line, II = obliquous rows, III = two rectangular rows, IV = triangular cluster, V = three in triangle, VI = on each side, one big single transversal paragnath, VII–VIII = double transversal rows (Figure 2A and 3A). Anterior notopodia with 2 conical, obtuse and sub equal ligules. The dorsal cirrus is somewhat longer than the dorsal ligules. Neuropodia with 2 rounded and conical lips, as short as inferior ligules. Dorsal ramus as long as ventral ramus. Notochaetae homogomph spinigers; neurosetae with homogomph spinigers and heterogomph falcigers and heterogomph spinigers and heterogomph falcigers, dark aciculae, 2 long anal cirri.

Perinereis macropus: Truncated body forward, attenuated posteriorly, 100-160 segments, head with long and strait prostomium, 2 pairs of eyes, 2 elongated palps, 2 pointed antennae and 4 pairs of tentacular cirri. The arrangement of the paragnaths agrees with that depicted by Fauvel (1923) as follows I = –3–7, II = triangular cluster, III = on each side, rectangular cluster for 3-5 denticles, IV = triangular cluster, V = 1 big and 5-12 subequal in irregular line, VI = on each side, one big single transversal paragnath, VII–VIII = big, conical and subequal paragnaths on band of 4-5 rows double transversal rows (Fig. 2B and 3B). Anterior notopodia, with 2 short triangular ligules, superior larger than inferior ligule, long dorsal cirri. Neuropodia with 2 short and large lips, conical inferior ligule and short ventral cirri. Notochaetae homogomph spinigers; neurochaetae with homogomph spinigers and heterogomph falcigers and heterogomph spinigers and exceptionally 1–2 heterogomph falcigers, dark aciculae, 2 long anal cirri.

Nereis falsa: Tapering body, 70–90 segments, long prostomium, 2 pairs of eyes, 2 ovoid palps, 2 pointed antennae and 4 pairs of tentacular cirri. Paragnaths are arranged as follows: I = two, II = arched clusters, III = rectangular clusters, IV = arched clusters, V = none, VI

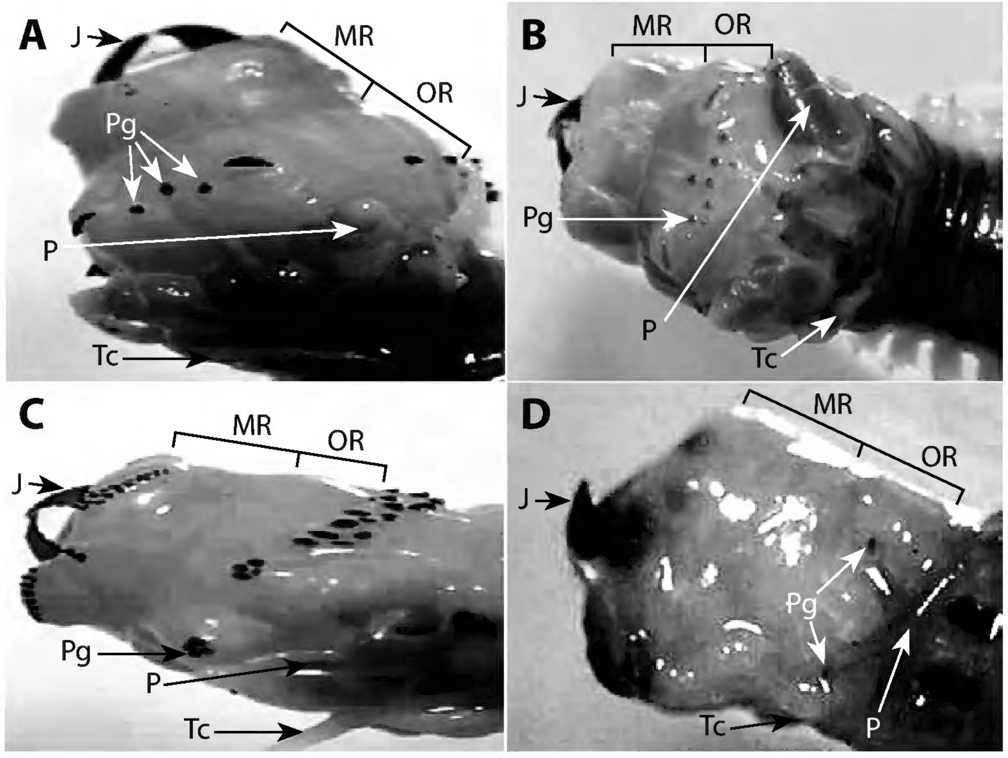

Figure 2. Dorsal views of pharyngeal areas (×8). **A:** *Perinereis cultrifera*. **B:** *Perinereis macropus*. **C:** *Nereis falsa*. **D:** *Platynereis dumerilii*. J: Jaws; P: Palps; Pg: Paragnaths; TC: Tentacular cirri; MR: Maxillary ring; OR: Oral ring.

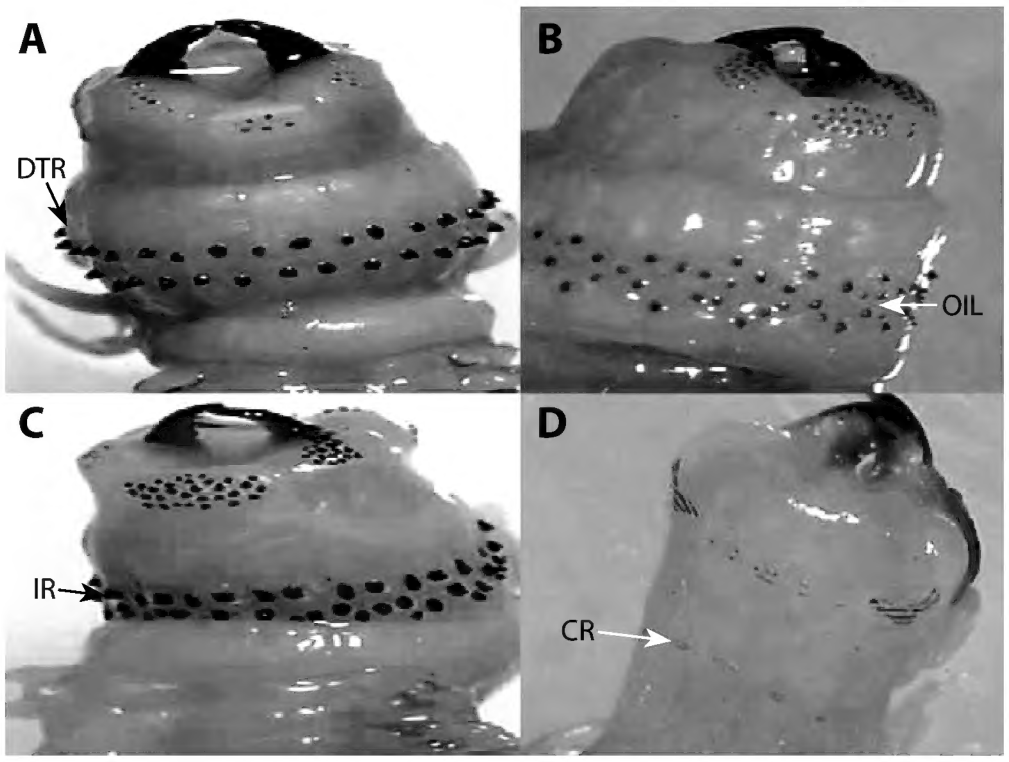

Figure 3. Ventral views of pharyngeal areas (×8). **A:** *Perinereis cultrifera*. **B:** *Perinereis macropus*. **C:** *Nereis falsa*. **D:** *Platynereis dumerilii*. CR: cluster rows; DTR: Double transversal rows; IR: irregular rows; OIL: one irregular line.

= 4 big paragnaths arranged in cross on each side, VII–VIII = 2–3 irregular rows of sub equal denticles (Figure 2C and 3C). Anterior notopodia with 2 conical, equal, the superior ligule is slightly hunchbacked and dorsal cirri as long as the superior one. Neuropodia with 2 conical, rounded and thick lips; as long as ventral cirri. Notochaetae homogomph spinigers; neurochaetae with homogomph spinigers and heterogomph falcigers and heterogomph spinigers, dark aciculae, 2 anal cirri.

Platynereis dumerilii: Tapering body, 70–90 segments, truncated prostomium, 2 pairs of eyes, 2 ovoid palps, 2 pointed antennae and 4 pairs of tentacular cirri. Paragnath are arranged as follows: I = none, II = none; III = small transverse clusters in two rows, IV = parallel rows of pectinate bars; V = none; VI = 1–2 concentric arcs on each side, VII–VIII = 5–7 clusters of 1–2 rows. 2 triangular. (Figure 2D and 3D). Anterior notopodia

with conical and sub equal ligules. Dorsal cirri long exceed length of dorsal ligule. Neuropodia with 2 obtuse, slightly shorter than median ligules. Ventral cirrus slender, tapering, slightly shorter than ventral ligule. Notosetae homogomph spinigers; neurosetae with homogomph spinigers and heterogomph falcigers, inferior ventral chaetae heterogomph spinigers and heterogomph falcigers, dark aciculae, 2 long anal cirri.

Interannual and intraseasonal variability in species composition

The interannual and intraseasonal variability in species composition from the four study sites is shown in Figure 4.

Perinereis cultrifera was observed at the four sites in 2011, 2012 and 2013. The presence of *P. macropus* in 2011, 2012, and 2013 was restricted to El-Kala, Skikda and Collo. *Nereis falsa* was observed in 2011 in El-Kala, Annaba and Skikda but in 2012 and 2013 it was not observed in Skikda. Finally, *P. dumerilii* was only present at El-Kala.

Perinereis cultrifera: In 2011, 1,142 worms were collected at the four sites with 389 individuals present at El-Kala, 317 at Annaba and 307 at Skikda throughout the year except in July and August. At Collo, 129 individuals were observed in Collo only from January to May. During the year 2012, 1,166 worms were collected from different sites, while they were absent at El-Kala from June to September. Individuals were not noticed at Annaba from January to March and from June to September. In Skikda, 582 worms were collected from January to June and from September to November. For Collo, 101 individuals were observed from April to June and much less (22) in September . In 2013, it was found that the number of worms collected varied among sites: i.e., 155 at Collo, 287 at Skikda, 407 at El Kala and 506 at Annaba. Worms were absent at El-Kala from June to August and from June to September in Annaba. Individuals were not observed at Skikda from June to October and in February and March and from July to November at Collo.

Perinereis macropus: In January, March and April 2011, only 45 individuals were observed at El-Kala; worms were present at Skikda (144) from April to June and November and December, and were present at Collo (162) from January to April and in August and September. In 2012, 73 individuals were found at El-Kala in March and April and from August to October; specimens were collected in Skikda in March and April (66). In Collo, worms were only detected (167 individuals) from January to April and from September to October. During the year 2013, 90 individuals were present in El-Kala during a spring and autumn periods. The worms were only observed in Skikda from March to April (44), while they were not noticed in Collo from May to September. In Annaba, no individuals have been harvested during the two years of studies 2012 and 2013.

Nereis falsa: For the year 2011, 310 individuals of *N. falsa* were observed in El-Kala. The number of individuals registered was lower (103) at Annaba since February to September. Only 32 worms were noticed in Skikda from May to December . In 2012, the presence of *N. falsa* was confirmed during all the year in El-Kala (352), while they were almost missing from January to May in Annaba. During the year 2013, 189 worms were collected in El-Kala. However in Annaba, they were present from March to May (30) and from July to December (65). Moreover, a total absence of this species was noticed in Skikda and in Collo.

Platynereis dumerilii: The presence of *P. dumerilii* was reported only in El-Kala. The individuals were rarely observed from March to April (03) and from September to October (05). In 2012 as in 2013, the worms were only observed in March 2012 and in April 2013 with respectively 34 and 24 individuals.

Interannual and intraseasonal variability in reproductive parameters

Table 1 shows interannual and intraseasonal variability in reproductive parameters at the four study sites. *Perinereis cultrifera*, *P. macropus*, and *Platynereis dumerilii* reproduce after acquiring the epitokous form between April and May while *N. falsa* reproduces without epitokal modification between July and August.

In *P. cultrifera*, the highest mature oocytes values were observed in El-Kala, Annaba, Skikda and Collo in 2012 (279.82 ± 13.04; 225.01 ± 8.57 and 251.99 ± 16.87 μm) and in Annaba in 2011 (201.66 ± 16.76 μm). The mean oocytes diameter of mature females was significantly higher ($p < 0.05$) at El-Kala compared to Annaba, Skikda and Collo throughout the study period. In *P. macropus*, the highest mature oocytes values were observed in El-Kala in 2013 (278.25 ± 6.02 μm), in Skikda in 2012 (258.50 ± 5.25 μm) and at Collo in 2011 (278.25 ± 4.42 μm). We did not observed statistically significantly trends in mean oocyte diameters of mature females during the study period and between sites. In *N. falsa,* the highest value of mature oocytes was observed at El-Kala in 2012 (168.00 ± 1.63 μm). We did not notice statistically significantly trends in mean oocyte diameters of mature females during the study period and between sites. Finally, concerning *P. dumerilii,* we observed only mature females at El-Kala. The mean oocyte diameters of mature females were not significantly different during the study period (mean diameter oocyte fluctuating between 162 and 166 μm).

DISCUSSION

This study aimed to establish an inventory of nereidid polychaetes from intertidal rocky shores along the east coast of Algeria and to measure interannual and intraseasonal variability of their presence and reproductive

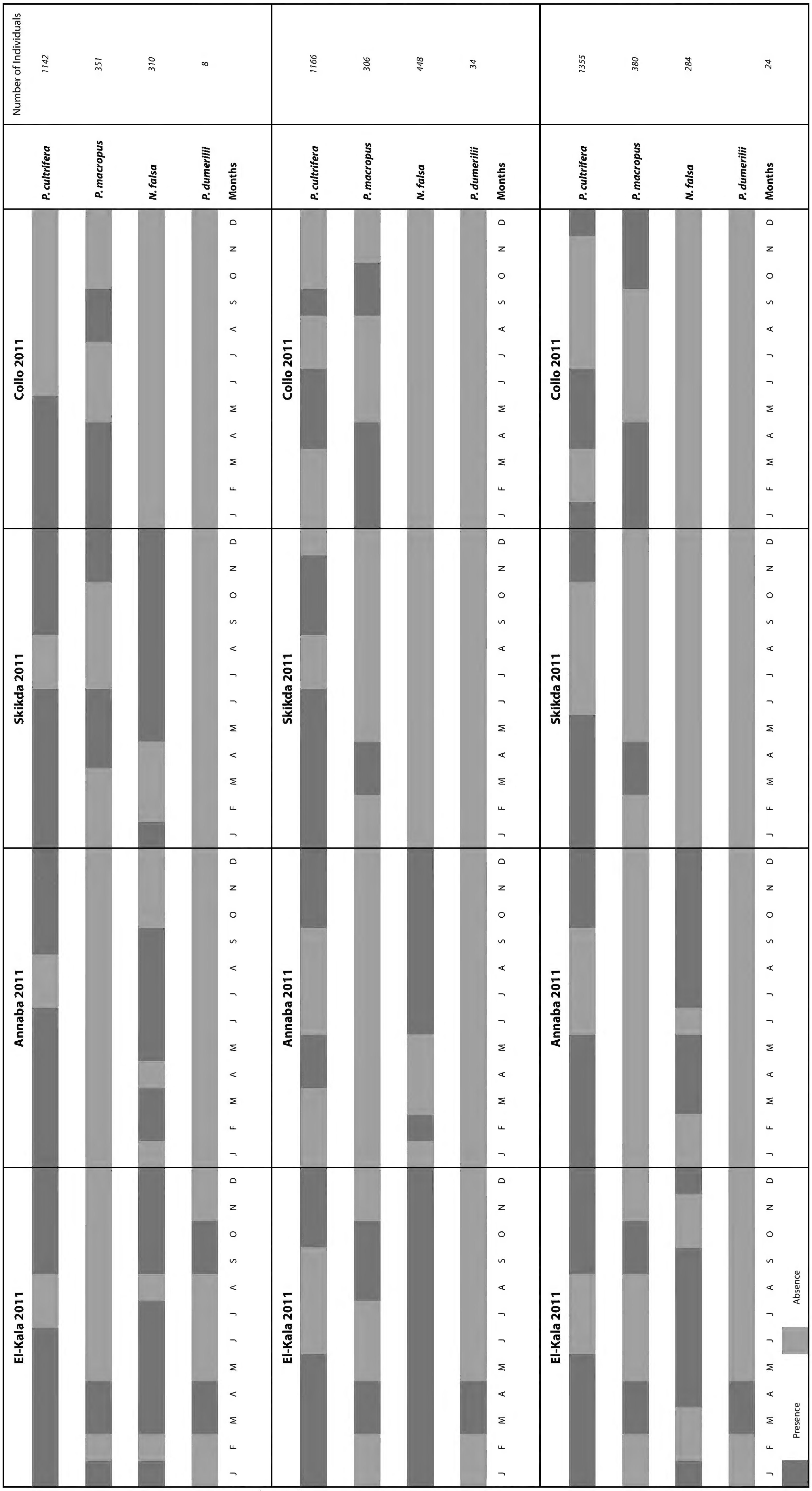

Figure 4. Interannual and intraseasonal variability in species composition from the study sites.

parameters. Four species of nereidid polychaetes (*Perinereis cultrifera*, *Perinereis macropus*, *Nereis falsa*, and *Platynereis dumerilii*) were identified during three years (2011, 2012 and 2013) in four intertidal, rocky shore sites (El-Kala, Annaba, Skikda and Collo).

Perinereis cultrifera is known to occur in the Mediterranean Sea (Gravier and Dantan 1928; Peres and Rancurel 1948; Durchon 1957; Marcel 1962; Bellan 1964; Ansaloni et al. 1986; Zghal and Ben Amor 1989; Rouabah and Scaps, 2003), the Atlantic Ocean (Cazaux 1965; Rouhi et al. 2008), the English Channel (Fauvel 1916; Herpin 1925; Durchon 1951; Cabioch et al. 1968; Scaps et al. 1992) and the Indian and Pacific oceans (Fauvel 1923; Wu et al. 1998).

Perinereis macropus seems to be restricted to the Mediterranean Sea (Fauvel 1923; Zribi et al. 2007) and the North Atlantic Ocean (Bellan 2001).

Nereis falsa has a wide geographical distribution. This species has been recorded along the East coast of the Atlantic Ocean (Day 1967; Fadlaoui and Retière 1995; Glassom and Branch 1997; Vittor 1984, 1997a, 1997b, 1998; Posey et al. 2002, 2006; Baez and Ardila 2003; Arana and Diaz 2006) and the Mediterranean Sea (Alliani and Meloni 1999; Sanchez-Moyano et al. 2001; Andrea and Giancarlo 2003; Guerra-Garcia et al. 2003; Guerra-Garcia and Garcia-Gomez 2004; Ertan Cinar et al. 2008). Moreover, this species lives as epibiont on Loggerhead Turtles, *Caretta caretta* (Linneaus, 1758), nesting on the coast of Georgia, U.S.A. (Pfaller et al. 2006), and on mussels, *Mytilus galloprovincialis* Lamarck, 1819, in Izmir Bay, eastern Mediterranean (Ertan Cinar et al. 2008). The species is a facultative rafter; i.e., it typically lives in benthic habitats but may become dispersed while being associated with floating items (Thiel and Gutow 2005).

Platynereis dumerilii was initially reported from the Mediterranean Sea, later from many parts of the world and, in the more recent taxonomic literature (Petitbone 1963; Hartmann-Shroeder 1996), it has been considered cosmopolitan in warm seas. However, *Platynereis megalops* (Ernst, 1914), described from the east coast of the U.S.A., was later ascribed to the species *P. dumerilii* on the basis morphological reasons. However, *P. megalops* differs from *P. dumerilii* at least by its highly sophisticated and remarkable mating behavior (Just 1914) and is certainly a different species. *Platynereis dumerilii* is further reported from the coasts of North Africa, the Irish Sea, and the Isefjord in Denmark (Hartmann-Shroeder 1996).

Thus, the records of the four nereidid polychaetes species from the east coast of Algeria are within the known range of each of these species.

Interannual and intraseasonal variability in species composition

The temporal distribution of species showed fluctuations between sites and seasons. During the whole duration of this study, *P. cultrifera* is the only species that was observed during most of the year except in summer. Individuals of *P. macropus* were observed at El-Kala, Skikda and Collo (mainly at the end of winter and at the beginning of spring) for all three years of this study. Individuals of *N. falsa* were observed during most of the year at El-Kala and Annaba. This species was observed at Skikda in 2011 but then disappeared in 2012 and 2013. Finally, *P. dumerilii* was only detected at El-Kala for a few months (mainly in March and April). It should be noted that *P. cultrifera*, *P. macropus* and *P. dumerilii* reproduce after transforming into epitokous form during spring (see below) and that death occurs shortly after reproduction. Small individuals are more difficult to collect than large ones, and this is why individuals were not detected in summer (recruitment period). inability to detect individuals does not mean that they were not present. By contrast, *N. falsa*

Table 1. Interannual and intraseasonal variability in reproductive parameters of the four species at the studied sites.

Species	Period of reproduction	Mode of reproduction	Sites	mean oocyte diameter (μm) 2011	mean oocyte diameter (μm) 2012	mean oocyte diameter (μm) 2013
P. cultrifera	April- May	Epitokous	El-Kala	254.41 ± 15.09	279.82 ± 13.04	248.68 ± 12.78
			Annaba	201.66 ± 16.76	199.56 ± 11.34	188.78 ± 13.35
			Skikda	190.83 ± 14.27	225.01 ± 8.57	171.79 ± 9.18
			Collo	239.64 ± 11.49	251.99 ± 16.87	200.07 ± 10.36
P. macropus	April- May	Epitokous	El-Kala	275.75 ± 14.68	277.00 ± 8.16	278.25 ± 6.02
			Annaba	Absence	Absence	Absence
			Skikda	256.50 ± 6.95	258.50 ± 5.25	255.25 ± 5.18
			Collo	278.25 ± 4.42	277.25 ± 4.64	276.50 ± 4.79
N. falsa	July-August	Atokous	El-Kala	165.25 ± 4.92	168.00 ± 1.63	162.00 ± 3.16
			Annaba	157.00 ± 4.08	152.75 ± 4.03	160.25 ± 4.27
			Skikda	153.50 ± 3.51	absence	absence
			Collo	absence	absence	absence
P. dumerilii	April- May	Epitokous	El-Kala	166.00 ± 2.58	167.00 ± 1.82	162.00 ± 2.16
			Annaba	absence	absence	absence
			Skikda	absence	absence	absence
			Collo	absence	absence	absence

reproduces without epitokal modification (see below), and as a consequence, its presence was detected during most of the year.

Variations in the presence of species among sites may be due to the geographical position of the sites, pollution, and/or destruction of the habitat by local fishermen (e.g., use of chemical to force the worms out of their burrows causing a dramatic destruction of the algal cover; Younsi et al. 2010). The distribution of worms reflect the differences in diet and/or dominant mode of feeding. In this sense, the site at El-Kala, which is part of a national park, free from pollution and devoid of destructive methods to collect worms, is the only site where we observed all four species of nereidid polychaetes. The three other sites are all located near cities and are exposed to pollution by pesticides/heavy metals (Annaba), and PAH (Skikda), or populations of worms are collected by local fishermen for bait. This can explain why these sites are species-poor as compared to El-Kala.

Mode of reproduction and reproductive parameters

Data on the reproductive biology of nereidid polychaetes from the east coast of Algeria and the coast of Tunisia are scarce. Although the nereidid polychaetes collected from the Algerian east coast of the Mediterranean Sea occupy the same type of environment (hard substratum covered withred algae), the mode of reproduction and reproductive parameters differ from one species to another. For different species, the epitokous form occurs between April and May when the sea-water surface temperature starts rising (20 – 23°C). The highest mature oocytes values was about the same for *P. cultrifera* (279 µm) and *P. macropus* (278 µm) while it was smaller for *P. dumerilii* (166 µm). Our results are in agreement with those reported from Saint-Cloud near the Tunisian border, which found that *P. cultrifera* reproduces exclusively by epitoky in late March or early April and the diameter at maturity is approximately 250 µm (Rouabah and Scaps 2003).. The reproductive season of *P. macropus* stretches from March to June in the Gulf of Gabes, Tunisia, and mature oocytes range between 220 and 300 µm in diameter with a mean of 250 µm (Zribi et al. 2007). Fischer and Dorresteijn (2004) indicated that and full-grown oocytes of *P. dumerilii* measure 165 µm.

The mode of reproduction (atoky, epitoky) distinguishes two forms of *P.cultrifera* in relation to geographical location of this species. According to the geographical localization of populations, reproduction of *P. cultrifera* is of an epitokous or an atokous state. Reproduction in the English Channel (Fauvel 1916; Herpin 1925; Durchon 1951; Scaps et al. 1992; Scaps et al. 2000) and the Atlantic (Cazaux 1965) is of an epitokous type, as it is at Salammbo (Zghal and Ben Amor 1989) and in the Venice Lagoon (Ansaloni et al. 1986) in the Mediterranean Sea. However, Gravier and Dantan (1928) and Durchon (1957) indicated that reproduction is mainly of an atokous type at Algiers; the heteronereid form exists but it is exceptional. In fact, Gravier and Dantan (1928) collected only two epitokous individuals during numerous nocturnal samplings. Durchon (1957) observed only two epitokous individuals during the three years of research he spent in Algiers. This led him to conclude that the epitokous form is present throughout the area of distribution this species, particularly in the hotter areas (Senegal). Nevertheless, Peres and Rancurel (1948) indicated that *P. cultrifera* reproduces exclusively by epitoky at Marseille, but Bellan (1964) did not find the epitokous form on the Provence coast. Moreover, Marcel (1962) studied the life cycle of *P. cultrifera* over one year at Algiers and never collected epitokous individuals. Based on this information, reproduction by epitoky at Algiers is a rare and minor phenomenon.

In contrast to the other three species of nereidid polychaetes, *N. falsa* reproduces without epitokal modification between July and August when sea temperature was highest. The highest mature oocytes values (168 µm) is about the same as *P. dumerilii* but is much small than those of *P. cultrifera* and *P. macropus*. This result is in agreement with that reported from El-Kala by Daas et al. (2010) who showed that during the year 2007 *N. falsa* reproduces exclusively by atoky from the end of July to early September and that the mean diameter of mature oocyte was approximately 167 µm.

The average diameter of mature oocytes of *P. cultrifera* found in El-Kala was significantly higher compared to the other sites investigated during this study. The discrepancy in the egg diameter was assumed due to differences in the environmental conditions and food in the waters that have an impact on the formation and development of gametes. The diameter of the oocytes depends on the condition of the waters in which the organism lives. Organisms living in less nutrient waters will produce low diameter eggs and otherwise those living in nutrient rich waters will produce high diameter eggs. El-Kala is part of a national park and is not urbanized compared to the other sites; so, environmental conditions in El-Kala are certainly optimal for the growth of oocytes. It should also be noticed that at the exception of Annaba, the highest mature oocytes values were observed in 2012. So, we can postulate that the amount of nutrients in waters was more important in 2012 compared to 2011 and 2013.

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